The positive contribution of these matters to the selection problem is to enable us to see the important rôle played by Mendelism in the effectiveness of selection. Hereditary variations, such as give rise to the multiple allelomorphs and multiple modifying factors, occur in some organisms rather infrequently, as measured by the time scale of human happenings. If there were no interchange of factors among individuals and stocks, it would take a long time to obtain in one individual all the six diluters of the eosin color of the *Drosophila* eye; one arises in one individual, another in another. But by selective crossbreeding it is possible to bring together into one stock all the modifiers that have been produced in diverse stocks. Mendelism acts as a tremendous accelerator to the effectiveness of selection.

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A WING MUTATION IN PIOPHILA CASEI

IN the early part of December, 1915, I began to breed the "cheese skipper" *Piophila casei*, in order to see if mutations were to be found in this fly. The source of my stock was a small piece of Italian cheese containing a dozen or so larvæ.[1] As these were doubtless the offspring of one female, inbreeding has been very close. Up to June 22, 1916, only one heritable mutation had been found among the thousands of individuals bred; this was the wing defect described below, which was first noted on March 12, 1916.

[1] This work was carried on at the Osborn Zoological Laboratory, Yale University, New Haven, Connecticut. It was in New Haven that I obtained the cheese. Contribution No. 135, Zoological Laboratory, University of Texas.

The Defect.—When viewed from the dorsal surface the defect appeared as a blister of variable size on the proximal and posterior part of the wing. From the ventral surface it appeared as a pit. Occasionally a real blister filled with fluid was obtained. The position of the defect was constant; when small it lay in the posterior cell just below the discal cell. When large it involved nearly the whole wing including the axillary, anal, second basal, discal and posterior cells. Usually both wings were affected alike, but here and there flies were found with one wing normal and the other wing severely affected.

This factor is strikingly similar, both in its appearance and the variability of its behavior, to the "balloon wings" found by Morgan[2] in *Drosophila* and more recently fully described by Marshall and Muller.[3] The flies carrying the defect, in my cultures, were very frequently sterile, and in no case did their fertility begin to approach that of normal stock.

In breeding, the character behaved as a mendelian recessive. Normal crossed with balloon gave, in the F_1 generation, 196 normal and no affected individuals. (This included 4 matings.) When brother and sister were mated, in the F_2 generation, 312 normal and 111 balloon offspring were obtained This is very close to the expected 3:1 ratio, of a monohybrid cross. When balloon flies were crossed, all individuals were affected (74 offspring obtained) but the character showed itself extremely variable; in some cases the flies appeared normal until very closely examined.

The defect was not sex-linked as is shown by the following mating. A defective female was mated with a normal male of normal stock. Of the 50 offspring resulting both males and females were normal.

The variation in the appearance of the balloon flies suggested either that the size of the blister was dependent upon some unknown environmental factors, or else, was due to multiple allelomorphs or multiple factors. A great number of matings were made to gain light on this point, but due to the sterility of the affected individuals, the evidence is not sufficient to allow us to draw any conclusions. Two individuals both of whom were severely affected were crossed. The 20 offspring resulting were all severely affected. Two individuals, both of whom were only

[2] In Morgan's "A Critique of the Theory of Evolution."

[3] Marshall and Muller, *Jour. of Exp. Zool.*, Vol. 22, 1917.

slightly affected, were crossed. Of the 29 offspring resulting, 17 showed the defect in a severe form, and 12 showed only small blisters. A female which had only one wing affected, was mated to a male, one of whose wings was severely affected while the other bore a very small blister. Of the 45 offspring resulting, 27 bore the defect in a severe form on both wings and 18 showed small blisters again on both wings.

Further experiments with this new character were under way when the work was stopped by the mobilization of the Militia in June. The work with these flies, however, is again being resumed.

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A CASE OF REGENERATION IN PANULIRUS ARGUS[1]

THE occurrence of regenerative processes in the crustacea has been a matter of record for a number of years, but the instances have been mostly confined to the regeneration of appendages and portions of the nervous system. Observations on the regeneration of portions of the exoskeleton of the trunk are far less numerous. The present observations on the regeneration of a portion of the rostrum of *Panulirus argus*, the common crayfish of the Bermuda Islands, were made during the summer of 1916 at the Bermuda Biological Station.

Panulirus argus when full grown is about 14 to 16 inches in length. It lacks chelipeds, their place being taken by the ordinary type of walking appendage. None of the walking appendages is provided with nippers, all being tipped with a single hook, as, *e. g.*, in the fourth pair of appendages of the crayfish *Cambarus*. The rostrum of *Panulirus*, instead of being a single median projection, consists of a pair of long (30–35 mm.), sharply pointed spines, slightly compressed laterally, and growing out from the carapace just posterior and slightly dorsal to the base of the eye-stalks.

The animal in question was a half-grown male, eight and one half inches long. When caught, June 20, the left spine (compare figure and explanation) of the rostrum was entirely missing. The carapace around the base was jagged and rough, as though the break had been recent; but a thin, soft membrane had

[1] Contributions from the Bermuda Biological Station for Research, No. 58.